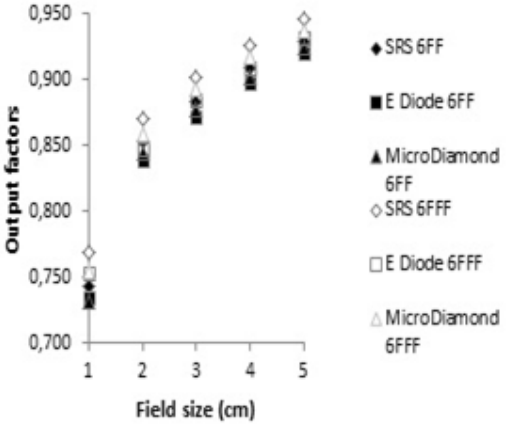
planning systems: Varian's Eclipse for extracranial treatments and with Brainlab's iplan for intracranial treatments.
Results: Output factors of 1000 SRS agreed with semiflex measurements for field size between 3x3cm² and 10x10 cm². The larger deviations were observed for the 1x1 cm² field size: compared to microDiamond, deviations of 1.6%, 2.5%, 1.7% and 3.3% were observed for 6, 10 MV FF and 6, 10 MV FFF respectively. For the 2x2 cm² field size, deviations were less than 1.5% for 6 MV FF and 6 MV FFF and 2.5% for 10 MV FF and 10 MV FFF. The 1000 SRS showed large dependent dose rate response. This effect was about 1% for 6, 10 MV FF and increased to 2.5% for 6 MV FFF and 4% for 10 MV FFF.
Stereotactic treatment plans gave excellent agreement with more than 95% of pixels passing 2%/2mm gamma criteria.



Conclusions: The 4D octavius phantom with associated 1000 SRS ionization chamber array could be used for stereotactic pretreatment QA of FF and FFF beams. It is however mandatory to calibrate 1000 SRS for a field size and a dose rate close to the patient treatment plan.

EP-1407

Quality Assurance on Helical Tomotherapy Treatments with small target and high modulation factor using ArcCHECK

C.W. Kong[1], Y.W. Ho[1], H. Geng[1], W.W. Lam[1], T.L. Chiu[1], W.K. Wong[1], S.K. Yu[1], K.Y. Cheung[1]
[1]Hong Kong Sanatorium & Hospital, Medical Physics and Research Department, Happy Valley, Hong Kong (SAR) China

Purpose/Objective: When ArcCHECK (Sun Nuclear Corp., Melbourne, FL) is used for Quality Assurance (QA) on helical Tomotherapy treatment plans, Tomotherapy measurement mode is applied and there is no correction on diode response for field size dependency. It is recommended to use a standard size 40x5 cm^2 of Tomotherapy static beam for ArcCHECK absolute dose calibration . Under such dose calibration ArcCHECK measurement does not produce good result for helical treatment plan with small target (dimension < 3 cm) and high modulation factor (>2.5), with gamma passing rate (3% dose, 3 mm distance to agreement) normally below 85% in absolute dose comparison. During such helical treatment, there are fast and frequent movement of small number of MLC leaves while the gantry is rotating. It is similar to small field irradiation at many different gantry angles. Solid state diodes on the ArcCHECK are slightly energy dependent and more sensitive to low energy component of the treatment beam. As the energy spectrum of treatment beam changes for small field size, the sensitivity of the diodes changes correspondingly. In this work the ArcCHECK measurements were done on 10 helical Tomotherapy treatment plans with small target and high modulation factor, with ArcCHECK calibrated under standard field (40x5 cm^2) and small field (2x2cm^2) treatment beam respectively to demonstrate if it is necessary to do small field dose calibration on ArcCHECK for such Tomotherapy treatment QA.
Materials and Methods; 10 helical Tomotherapy treatment plans, with small target size (dimension < 3cm) and high modulation factor (>2.5), were used in the study. ArcCHECK absolute dose calibration was done initially with a standard field (40x5 cm^2) and 0.057 cc ionization chamber (A1SL, Standard Imaging Inc, Middleton, WI). Absolute point dose measurements were also done by placing A1SL ionization chamber at the centre of the ArcCHECK with PMMA insert. After ArcCHECK measurement on these 10 helical treatment plans, absolute dose comparisons between the measurement and planning calculation were carried out with gamma test (3% dose, 3 mm). The measurements were repeated with ArcCHECK calibrated under small field 2x2cm^2. The difference between the responses of the chamber in the standard field and small field 2x2cm^2 was corrected in small field calibration.
Results: Absolute point dose measurements for all plans showed good agreement with planning calculation as the differences were all within ± 2%. When standard field size (40x5 cm^2) calibration was used, the gamma passing rate of ArcCHECK measurements were below 85% (Mean=79.5%, S.D.=3.3%) for all plans. When small field (2x2cm^2) dose calibration was used instead, the gamma passing rates for all plans were over 90% (Mean=93.7%, S.D.=1.8%).
Conclusions: Sensitivity of the diode changes for small irradiation field. Small field (2x2cm^2) dose calibration on ArcCHECK should be used instead when measuring helical Tomotherapy treatment with small target and high modulation factor in order to correct such sensitivity change.

EP-1408

Stereotactic Radiation Therapy (SRS/SBRT) pre-treatment QA: two different approaches

N. Cavalli[1], N. Ricottone[2], E. Bonanno[1], G. Pisasale[2], A. D'Agostino[2], A. Girlando[2], C. Marino[1]
[1]Humanitas CCO, Medical Physics, Catania, Italy
[2]Humanitas CCO, Radiation Oncology, Catania, Italy

Purpose/Objective: Stereotactic radiation therapy (SRS/SBRT) require a more comprehensive quality assurance (QA) program than 3DCRT and IMRT (or VMAT), especially because of its very high-dose gradients. The purpose of this study is to test a IBA 3D dosimetry analysis package, COMPASS 3.0 with MatriXX^{Evolution} ion chamber array, for SRS/SBRT pre-treatment verification in terms of 3D dose, gamma analysis, Target and OAR structures DVH.
Materials and Methods: Nine treatment plans (SRS/SBRT) with different dose fractionations have been selected: 3 brain cases (2 cases of 21Gy x 1 and one of 15Gy x 1), 3 liver cases (15Gy x 3) and 3 lung cases (2 cases of 15 Gy x 3 and one of 8 Gy x 4). All measurements, performed with COMPASS, were compared with the reference dose

distributions calculated in Eclipse TPS; for the evaluation of pre-treatment verification agreement, $D_{100\%}$, D_{Mean} and $D_{1\%}$ and local γ analysis (2mm/2% - 3mm/3%) were investigated for CTV, PTV and OARs. The same cases were analyzed, in terms of γ analysis (2mm/2% - 3mm/3%) with our routinely pre-treatment verification system, based on EPID images and EPIQA software. Finally to test systems robustness, intentional errors have been introduced to the original position for one of the SBRT plans, in a first step closing the X_1 jaw, then opening a single leaf.

Results: Average differences, between Eclipse TPS and Compass reconstruction, in terms of $D_{100\%}$, D_{Mean} and $D_{1\%}$ for PTV result, respectively, 3.0 %, 1.9 %, 2.1 % for liver, 1.9 %, 1.1 % and 2.1 % for brain, 13 %, 4.2 % and 1.8 % for lung. Fig. 1 shows the worst scenario found in terms of differences between calculated and measured dose distribution; in this case local γ test fails for PTV and CTV (86,5 % and 82 %): it's due to a difference of +4 % in absolute dose inside the CTV. Even if this result could be not acceptable with conventional pre-treatment verification devices, the chance to investigate about dose differences inside the target and OAR, could be really interesting from a clinical point of view. For the same case the number of point with γ<1, found with EPIQA, is 96 %.

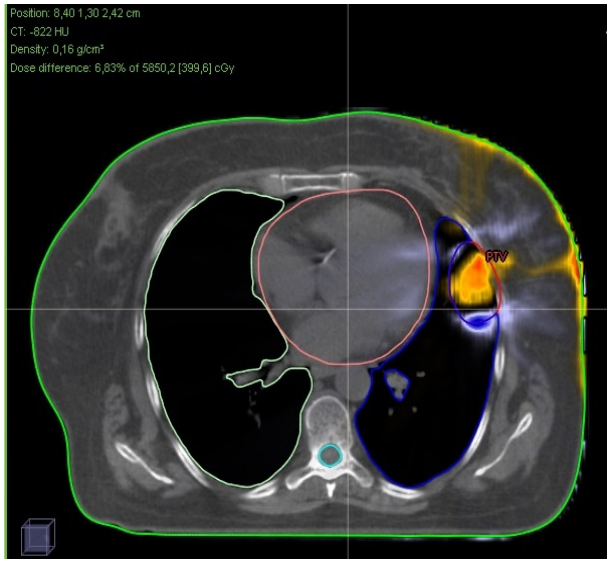


Fig. 1

Tab. 1 shows detected errors with two systems in terms of differences in $D_{100\%}$ and $D_{50\%}$, respect to the reference correct plan.

	ECLIPSE		COMPASS RECONSTRUCTED	
	$D_{100\%}$ Difference (Gy)	$D_{50\%}$ Difference (Gy)	$D_{100\%}$ Difference (Gy)	$D_{50\%}$ Difference (Gy)
2mm JAW (x1)	-0,1	-0,1	-0,1	-0,1
4mm JAW (x1)	-0,2	-0,1	-1,1	-0,1
5mm JAW (x1)	-2,4	-0,2	-2,6	-0,2
7mm JAW (x1)	-10,0	-0,4	-7,4	-0,3
9mm JAW (x1)	-15,6	-0,6	-16,4	-1,0
10mm JAW (x1)	-21,3	-1,1	-17,6	-0,8
2mmMLC	0,0	0,2	0,7	0,3
3mmMLC	0,2	0,4	0,8	0,5
4mmMLC	0,1	0,5	0,8	0,6
5mmMLC	0,1	0,6	0,8	0,7
MLC in field	-15,3	-1,1	-6,3	-1,7

Tab. 1

Conclusions: This work confirms that gamma approach for pre-treatment verifications could be not enough sensitive to decide about delivery. A system like Compass gives more completed information in terms of 3D dose distribution and DVH taking into account patients anatomy; it seems to be also capable to detect possible errors.

EP-1409

Clinical implementation of an EPID based in vivo dosimetry system

N. De Kerpel[1], N. De Maeseneire[1], T. Vercauteren[1], F. Decoster[1], Y. Lievens[1], C. De Wagter[2]
[1]*University Hospital Ghent, Radiotherapy, Gent, Belgium*
[2]*University Ghent, Radiation Oncology and Experimental Cancer Research, Gent, Belgium*

Purpose/Objective: The purpose of EPID in vivo dosimetry is to verify whether the predicted and delivered dose agree, both in terms of absolute dose and geometrical deposition. Dedicated software, the in vivo 3D DC (Dosimetry Check) system (Math Resolutions, Columbia), was implemented at our hospital to replace our pretreatment D4 (Delta4) system (Scandidos, Uppsala).

Materials and Methods: Math Resolutions was provided with output factors and dose profiles to model the dose kernels for our linear accelerators. Deconvolution kernels were created by measuring transit dose with the linac specific EPID panel for different field sizes at different thicknesses of water. The DC software handles 2 modes of operation. For transit dosimetry, the patient attenuated fluence is acquired during clinical treatment. For pretreatment dosimetry, the un-attenuated fluence is acquired. The main limiting factor of the system is the size of the sensitive region of the EPID panel (30x40 cm^2 for Varian and 41x41 cm^2 for Elekta). Since the height of the Varian EPID panel is variable, treatment plans with a larger field size can be measured as a pretreatment plan at a smaller SID.

Results: A tissue-equivalent polystyrene CarPet phantom of 20 cm thickness was used for the validation of the DC system. An agreement within 5% of the isocentric treatment plan dose was obtained for every clinically used combination of TPS and linac. Gamma criteria of 3mm/3% with pass/fail criteria of 95% for fixed-beam IMRT and 90% for VMAT have been used at our department for measurements on the presumed homogeneous D4 phantom. For pretreatment DC dosimetry, relaxed gamma criteria of 3mm/6% were applied since the dose is reconstructed on the heterogeneous CT-based model of the patient. Taking into account setup errors inaccuracies and patient anatomy uncertainties, gamma criteria of 5mm/6% were used for transit DC dosimetry. For both systems, a threshold of 20% of the prescribed dose was applied to exclude false positive influences of low dose regions. For lung cases, the pencil beam algorithm used in DC did not meet our requirements for accurate dose reconstruction. Therefore, we applied a density override in the patient lung region in both dose planning and DC dose reconstruction of pretreatment measurements. Primary test results suggest a better congruence with D4 γ results and with the acceptance isocentre dose difference (DD) specifications (overview in Table 1).